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The Navy's enlisted advancement system seeks to satisfy the requirements for petty officer personnel among ratings and paygrades and control the expenditure of its manpower budget. In addition, the system is intended to create a pool of petty officers for assignment to duty by paygrade and skill. Until recently, the tools for managing the advancement system were deficient. This report provides an overview of the new enlisted Advancement Interface System (ADIN), and a description of the advancement planning process. ADIN improves on the former system by using current versus up to 11-month-old personnel inventories, interfacing with other manpower forecasting models, computing "carrydown" vacancies, and incorporating features for easy use by computer-naive advancement planners.

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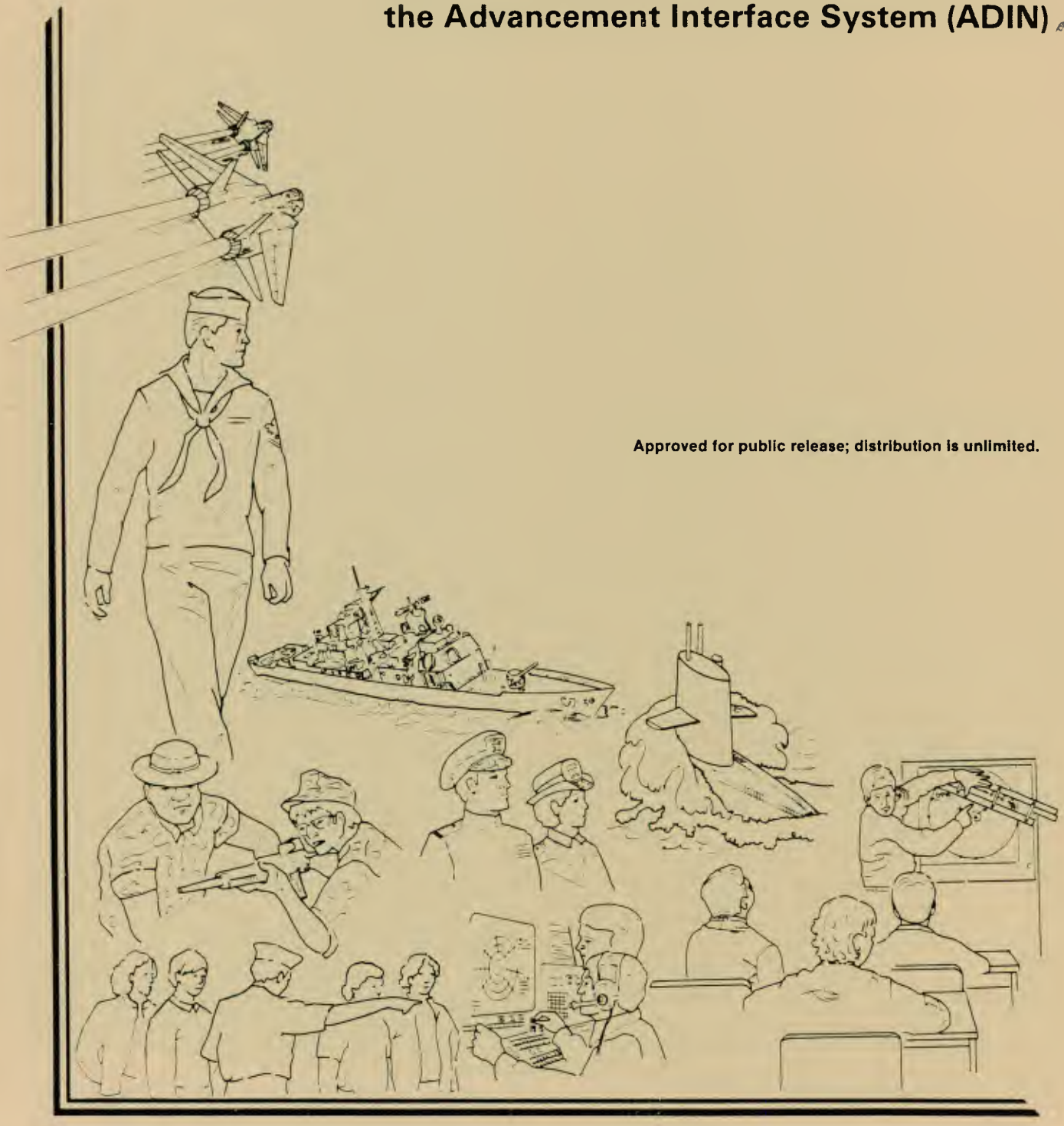

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Navy Enlisted Advancement Planning and the Advancement Interface System (ADIN)

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FOREWORD

This report describes the Navy's enlisted advancement planning process and provides an overview of the new computerized advancement planning system known as ADIN (the Advancement Interface System). The report is intented to serve as a primer on petty officer advancement planning, and is prerequisite to an understanding of the recently installed ADIN system. This research and development was conducted under work request WR25021 (FAST/FAIM/ADIN) and the sponsorship of the Deputy Chief of Naval Operations (Manpower, Personnel, and Training; OP-01). The ADIN system will be described in more detail in a subsequent report.

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SUMMARY

The Navy uses its enlisted advancement system to achieve requirements for petty officer personnel among its ratings and paygrades, to control expenditure of its manpower budget, and to create a pool of petty officers for assignment to duty. Until recently, the methods available for managing the advancement system were deficient. They were not capable of using the most recent strength data and failed to account for several critical personnel flows. Also, the methods were not linked computationally to other manpower management models. The careful planning required in managing advancements could no longer be supported by these methods.

This report provides an overview of the new enlisted advancement system, known as the Advancement Interface System or ADIN. The ADIN system has been deployed in the offices of the Deputy Chief of Naval Operations (Manpower, Personnel, and Training) since 1985. Its description is preceded by a "primer" on the advancement planning process. The primer includes a discussion of the objectives of advancement planning and the timing of events during the planning and execution of advancements. A series of examples are used to illustrate the methods used to determine the number of advancements by paygrade and their allocation among ratings.

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Through its enlisted advancement system, the Navy seeks to satisfy the requirements for petty officer personnel among ratings and paygrades and to control the expenditure of its manpower budget. In addition, the system is intended to create a pool of petty officers for assignment to duty by paygrade and skill. Centralized control of petty officer advancements increases the likelihood of meeting these objectives. Centralized management also requires processing of large volumes of data and numerous, complex calculations under considerable time pressure.

Until recently, the tools for managing the advancement system were deficient. The old advancement planning model did not account for a number of critical personnel flows, it lacked the capability to use the most current data available, and critical software interfaces with other manpower management models had fallen into disrepair. Rather than attempting to rehabilitate the old model, the Navy decided to develop a new, improved advancement planning system, known as the Advancement Interface System, or ADIN.

Background

Annually, the Congress establishes specific all-Navy strength and budgetary levels (including officers and midshipmen). The strength targets, known as authorized strengths, dictate the upper boundary for the size of end-of-fiscal-year personnel inventories. In addition, all services are constrained by law not to exceed 1 percent of their strength at E-9 and 3 percent at E-8 and E-9 combined. While constrained by authorized strengths, the Navy has flexibility in specifying individual paygrade targets (e.g., E-4, E-5). Without careful planning of advancements, achievement of these paygrade strength objectives would be left to chance.

In addition to the end-year strength objective, the enlisted force is also constrained by a budget. The budget is represented by the "man year average" (MYA) by paygrade--the average strength in a paygrade across the fiscal year. The advancement system is the mechanism for scheduling monthly advancements to maintain the desired average strength and stay within the allotted budget.

Finally, to maintain a state of readiness, adequate numbers of petty officers must be available to fill the Navy's operational billets. By regulating the supply of petty officers in each of the Navy's ratings (or occupational specialties), the advancement system assures an adequate flow of personnel to the Fleet.

These objectives can conflict. For example, the readiness objective might require advancements early in the year to meet assignment needs, while the budget objective might suggest delaying them until the end of the year to save money. Generally the readiness objective focuses on the paygrade strength of specific ratings, while budget objectives focus on the whole Navy.

Prior to the development of ADIN, the Navy used an advancement planning model developed in the early 1970s.[1] As requirements changed, however, the older model became deficient. First, the lack of data processing capabilities prohibited it from accessing the most recent year-to-date (YTD) data. For example, when the model was run in September, it did not have access to the YTD personnel flows (demotions, laterals, attrition, retirement, advancements, etc.) that occurred during the first 11 months of the fiscal year, nor did it have the most current inventories. So while inventories and personnel flows were available through the beginning of September, the old model was still using 11-month-old data, from October of the previous year. The use of old data resulted in avoidable errors, which were reflected in the advancement plan itself. For example, if the most recent inventory shows 200 fewer personnel than the only estimate available to the model, the advancement plan will underadvance by 200, resulting in a shortage.

Second, the model had limited access to projected inventory and personnel flow data from other models on which it was logically dependent. Among these models were the Strength Planning Model (SPAN), which provides all-Navy monthly inventory and personnel flow projections; the Force Analysis Simulation Technique (FAST) model, which provides annual inventory and personnel flow projections by rating; and the Automatic Advancement Model (AUTOA), which generates monthly automatic advancement projections by rating. Without these projections, the advancement plan is inconsistent with expected developments in other parts of the personnel system. For example, if SPAN's forecasts of increased retirement are not available to the advancement planner, the advancement plan will underadvance, and personnel shortages will result.

These deficiencies constituted a barrier to attainment of advancement planning objectives. Determining advancements to meet strength objectives over a 9- to 18-month planning horizon is difficult enough. The problem is compounded when the planning originates from a point up to 11 months earlier. In effect, this increases the advancement planning horizon to between 20 and 29 months. The longer horizon leads to more uncertainty, less accurate personnel forecasts and advancement plans, and deficiencies in readiness.

The old model was also computationally outdated. Its operation did not exploit any of the interactive controls or job submission aids so common to modern managerial software. It required substantial computer expertise on the part of the advancement planner or frequent intervention by data processing personnel.

Objective

This report introduces the new enlisted Advancement Interface System (ADIN). The ADIN system was developed to overcome many of the deficiencies found in the previous system. The description of ADIN is preceded by an introductory explanation of the

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[1] Advancement planning models have been used by the Navy since 1966, when ADPLAN I became operational (Conner & May, 1966; Conner & Quisenberry, 1966). An improved version of the model known as ADPLAN II was installed in 1968 (Naval Personnel Research Activity, 1967; Quisenberry, 1972). ADPLAN II was replaced by the ADIN model in April 1972. ADIN was the first advancement planning model with ties to other enlisted personnel models (Quisenberry, 1972; Silverman, 1971). Finally, the current advancement planning system, ADIN II (but referred to as ADIN throughout this report), replaced ADIN in September 1983, and provided additional systemic ties to both enlisted personnel models and the enlisted data processing system.

advancement planning process. A subsequent report will describe the structure and operation of ADIN in more detail.

NAVY ENLISTED ADVANCEMENT PLANNING PROCESS

Navy enlisted advancement planning can be viewed as a resource allocation problem. The demand for scarce personnel resources is represented by advancements required in each of approximately 100 ratings and six paygrades (E-4 to E-9).

The supply of personnel for advancement consists of those eligible for advancement in each of the paygrade/rating (rate) combinations. Personnel become eligible for advancement through a "mixed merit" system, in which centrally administered subject matter examinations constitute a significant part of the merit (as well as awards, performance ratings, etc.), and both time in service and time in grade constitute the Navy's minimal requirements for experience. For petty officers at paygrades E-4 to E-6, the examinations yield a reservoir of advancement eligibles ("testpassers") twice a year. For E-7, examinations are given once a year. Eligibility for E-8 and E-9 is based on performance evaluations and longevity alone; no examination is given. The receipt of advancement eligibles by the advancement planner triggers the development of plans which authorize the actual advancement of individuals during the "advancement cycle." Advancement plans for a 6- or 12-month advancement cycle (e.g., July through December) are compressed into as little as a 2-week period preceding the cycle (e.g., 27 April to 14 May). Figure 1 typifies the timing of testing, planning, and advancing E-4s through E-6s (for one of two "cycles" each year).

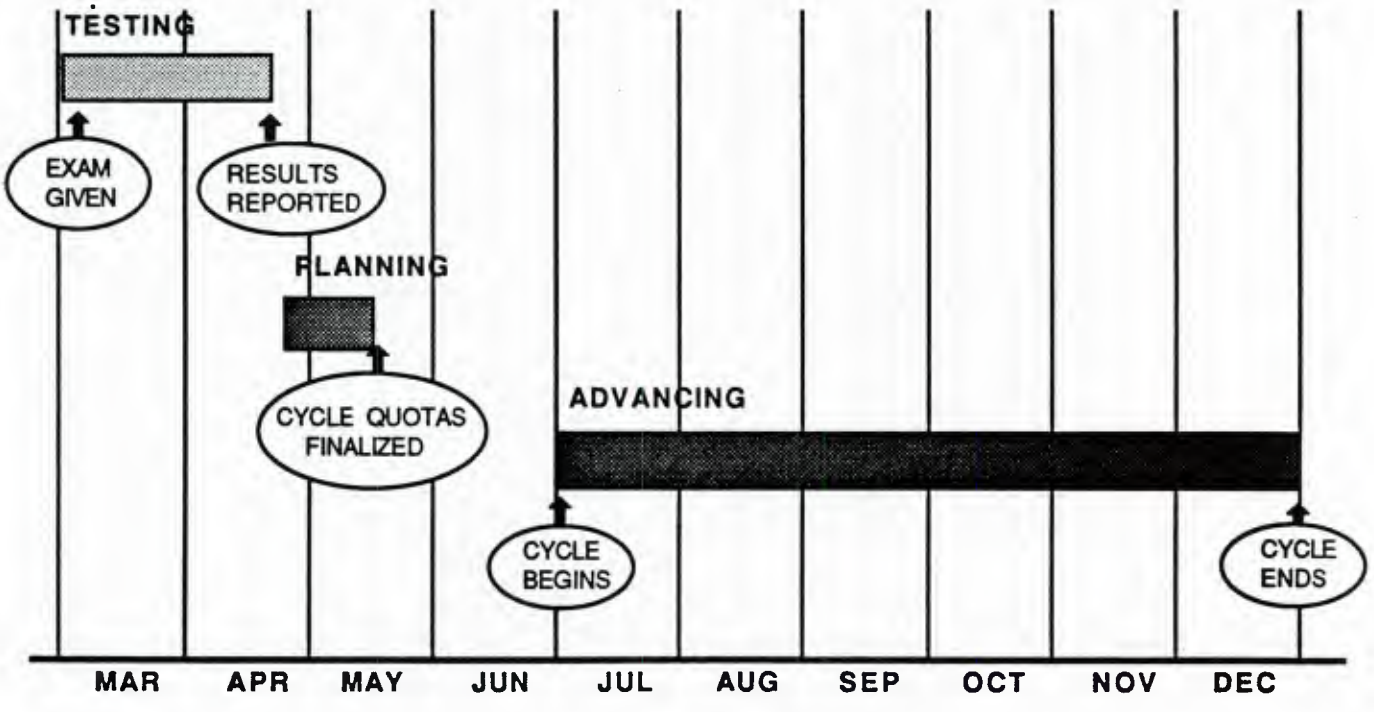

Figure 1. One of the two annual advancement cycles for E-4, E-5, and E-6.

The advancement planner has less than a month from receipt of the aggregate number of testpassers to generate the plan. During the subsequent advancement cycle, every attempt is made to execute the planned advancements.

The Demand for Advancements--"Advancements Required"

Advancement planning begins with computing the demand for advancements, known as "advancements required." This computation requires using authorized strength at the end of the advancement cycle, the expected inventory at the beginning of the advancement cycle, and the losses and gains expected to occur during the cycle. For those paygrades with a 6-month cycle, inventories are forecast 3 months into the future (e.g., from October to January), to produce the inventory for the beginning of the cycle. Losses and gains are projected for 3 to 9 months in the future (e.g., from January through June). First, a "net inventory" is derived by subtracting forecasted losses from and adding forcasted gains to the inventory that exists at the beginning of the cycle.[2] Then, the net inventory is subtracted from authorized strength. The remainder, known as vacancies, can be positive, negative, or zero. The computation of vacancies is illustrated in Figure 2.

Finally, the number of advancements required for a paygrade is the sum of vacancies at that paygrade and at all higher paygrades. The computation of required advancements is known as carrydown. Carrydown is illustrated numerically in Figure 3.

How Carrydown Works

In Figure 3, paygrade E-9 has a net inventory of 90 and an authorized strength of 100. Vacancies are therefore 100 minus 90, or 10. Because there are no higher paygrades, the number of advancements required for E-9 equals the number of vacancies. The number of personnel who have passed the test (15) exceeds the advancements required (10); so the number of advancements made equals the advancements required, with five eligible personnel not advanced. This produces an E-9 end strength of 100 (the net inventory of 90 plus the 10 advancements), which equals the authorized strength.

Paygrade E-8 starts with a net inventory of 180 and an authorized strength of 200. There are 20 vacancies. Because of carrydown, however, the number of advancements required is 30. This is because to achieve E-8 authorized strength, 20 advancements are needed to fill the vacancies created by losses, while another 10 are needed to replace the 10 E-8s promoted to E-9. Vacancies from higher paygrades carry down to lower paygrades

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[2] There are two basic types of losses and gains: strength and structural. A strength loss occurs when an individual leaves the Navy through attrition, retirement, or non-reenlistment. Similarly, a strength gain adds to the Navy strength and includes prior-service gains (e.g., broken-service reenlistments) and non-prior-service gains (recruits). Structural losses are not a loss to the Navy but rather a localized, or internal, loss to a rating or paygrade. Each structural loss is offset by a structural gain. So, structural transactions come in pairs, a loss and a gain. These pairs include laterals in and out, demotions in and out, and nonexamined advancements in and out (see p. 15). For example, a lateral out represents a loss to the rating the individual has left, while a lateral in represents a gain to the rating to which the individual moved. The demotions in and out and nonexamined advancements in and out are similar, except the movement occurs between paygrades rather than between ratings. Examined advancements are not considered in the forecast of gains and looses.

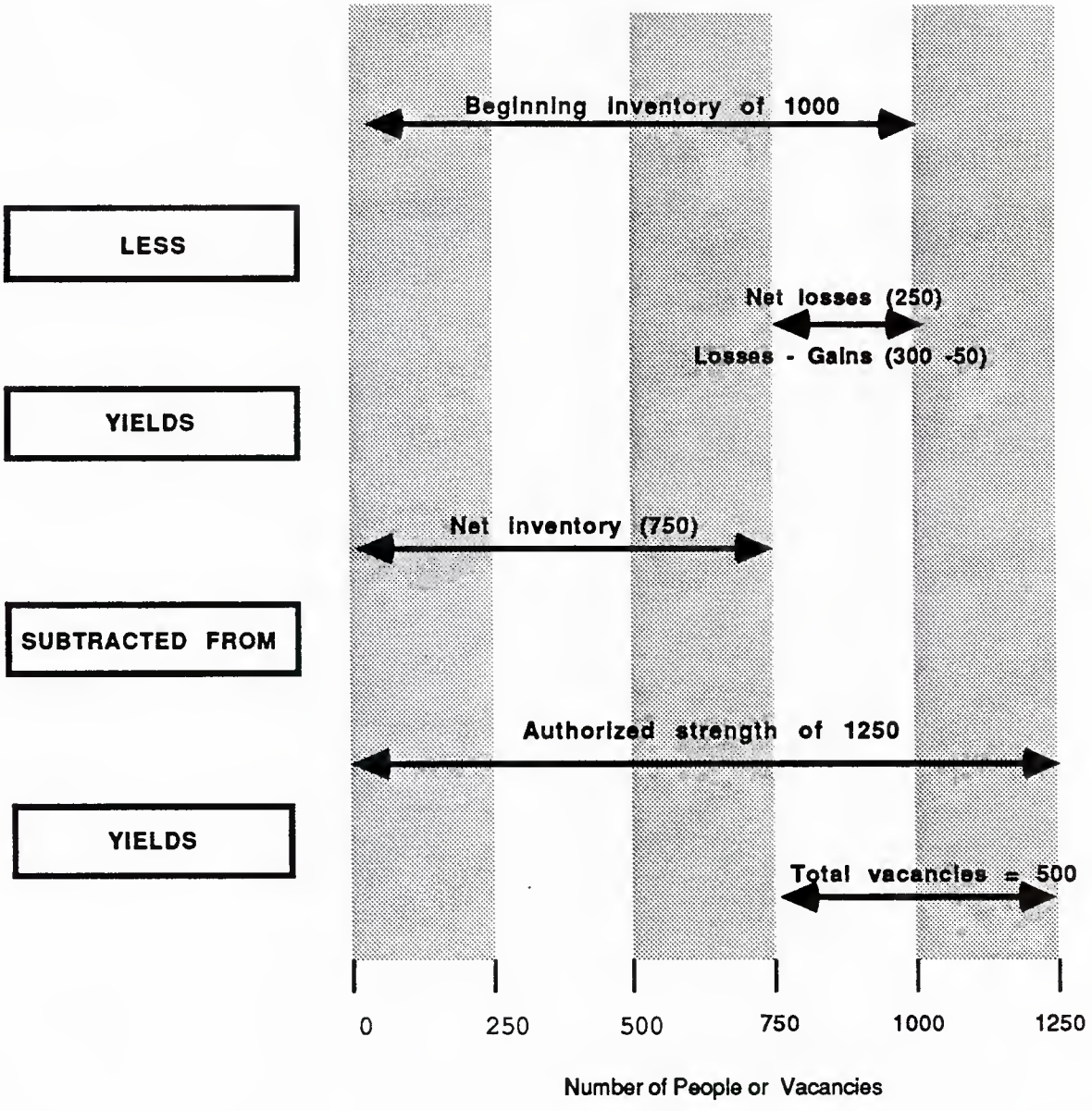

Figure 2. Computation of vacancies.

to create a need for additional advancements. In the example, the number of testpassers (40) exceeds the advancements required (30). The number of advancements made equals the advancements required, with 10 of those eligible for advancement not advanced. This produces an E-8 end strength of 200, equal to its authorized strength. The end strength is computed by subtracting the 10 advancements to E-9 from E-8, and adding the 30 advancements to E-8, to the net inventory of 180.

Pay-grade	Authorized Strength	Net Inventory	Vacancies	Advance Req'd.	Test-passers	Advance In	End Strength	Paygrade Shortage	Cumulative Shortage	Excess Test-passers
E-9	100	90	10	10	15	10	100	0	0	5
E-8	200	180	20	30	40	30	200	0	0	10
E-7	400	360	40	70	65	65	395	5	5	0
E-6	700	600	100	170	150	150	685	20	15	0
E-5	2000	1700	300	470	550	470	2020	0	-20	80
E-4	2300	2400	-100	370	870	370	2300	0	0	500
Total	5700	5330	370	1120	1690	1095	5700	25	0	595

Figure 3. Example of carrydown.

An insufficient advancement resources situation. The problem of insufficient advancement resources is introduced at E-7, where a net inventory of 360 and authorized strength of 400 yields 40 vacancies. The sum of the vacancies at E-7 thru E-9 (40 + 20 + 10) produces the number of advancements that are required. Because 65 are eligible for advancement and 70 advancements are required, advancements (65) fall 5 short of what is needed to achieve authorized strength. The resulting E-7 end strength is obtained by subtracting the 30 advancements to E-8 from E-7 and adding the 65 advancements from E-6 to E-7 to the net inventory of 360 (360 - 30 + 65 = 395).

A similar shortage occurs at E-6, but note how the shortages at E-7 carry down to compound it. E-6 has (700 - 600) = 100 vacancies. The number of advancements required is 170 (100+40+20+10). The number of testpassers (150) once again falls short of advancements required (170). Therefore, 20 fewer advancements are made than are needed. This deficit, the difference between advancements required and advancements made (170-150), can be viewed as the summation of the paygrade shortage (authorized strength minus end strength) of 15 at this paygrade plus the paygrade shortage of 5 from E-7.

At E-5, carrydown makes up for the shortage of advancement resources at E-6 and E-7, but leads to an end strength in excess of authorized strength. E-5 has a net inventory of 1700 and an authorized strength of 2000. There are (2000 - 1700) = 300 vacancies, and 470 advancements are required (300+100+40+20+10). Since the number of testpassers (550) exceeds the advancements required (470), the number of advancements made equals the advancements required, leaving 80 testpassers (550 - 470) not advanced. The number of advancements made leaves a surplus of 20 in E-5 strength, but it represents E-5 inventory in place of the 20 advancements that could not be made at E-6 and E-7.

Because of carrydown, even if vacancies at a paygrade are zero (or even negative), advancements required may be positive. This case is illustrated at E-4. E-4 has a net inventory of 2400, an authorized strength of 2300, and hence vacancies of (2300-2400) = -100. Despite the negative vacancies, the advancements required are still computed as before and equal 370 (-100+300+100+40+20+10). Since the number of testpassers (870) exceeds the advancements required (370), the number of advancements made equals the advancements required, with 500 testpassers not advanced. An end strength of 2300 (2400-470+370) results.

Carrydown benefits. The carrydown methodology has a number of benefits. First, advancements made at lower paygrades are computationally independent of advancements made at higher paygrades. Recall that the only variables used in computing advancements required were the beginning inventory, authorizations, gains, and losses. The number of advancements in or out of a paygrade is not used. As a result, the advancement planner can make changes to the number of advancements made at higher paygrades (e.g., due to a change in the number of testpassers) without affecting the calculations made for the lower paygrades.

Second, carrydown can ameliorate deficiencies (shortages or surfeits) in higher paygrades within a rating by its calculation of required advancements in lower paygrades. This was demonstrated in the carrydown example at paygrades E-5 through E-7. There were shortages of 5 and 15 at paygrades E-7 and E-6, respectively, which were carried down as an excess of 20 at paygrade E-5. The advantage is that additional personnel of a particular skill are "stockpiled" at the lower paygrades when attainment of authorized strength at the higher paygrades is not possible. When sufficient personnel at the lower

paygrades become advancement resources, both the lower and the higher paygrades will be properly manned.

Third, the underlying assumption of carrydown is that it is better to have personnel resources in a particular rating, even at the wrong paygrade, than not to have them at all. In effect, this assumption says that the difference between, for example, grades E-5 and E-6 is far less significant than the difference between Electronics Technician and Boatswain's Mate.

As the carrydown example showed, advancements required may not always be achieved. In fact, either a significant increase in authorizations or a shortage of personnel passing the advancement exam, or both, can cause this condition.

Conversely, a reduction in authorized strength can lead to an overmanned condition. Advancements required will then be negative and because a negative number of advancements is not possible, authorized strength will not be met.

Meeting All-Navy Advancement Goals

When advancements are being planned for some 100 ratings with wide-ranging manning conditions, inevitably some ratings will not meet their advancements required. The result is an imbalance in the desired paygrade end strength at the all-Navy level. To attempt to meet the all-Navy paygrade strength, a procedure known as "apportionment" is applied. Apportionment redistributes advancements among ratings to meet (or at least come closer to) the all-Navy advancement targets.

The assumption underlying apportionment is complementary to the assumption underlying carrydown. It is assumed that it is desirable to meet all-Navy requirements by paygrade even when it may be impossible to reach the same paygrade requirements in every rating. Put another way, it is desirable to achieve the amount of readiness (i.e., personnel) authorized by Congress at the all-Navy level, even if the skill mix is not ideal.

Apportionment takes two forms--positive and negative. Positive apportionment is used when, after performing the advancement procedure described earlier for each rating, there are still insufficient paygrade advancements to satisfy the all-Navy requirement. In the simplest instance, this can occur because only one rating did not have sufficient testpassers to fulfill its advancements required. Assuming that all other ratings meet their advancements required, there will be a shortage at the all-Navy level equal to that of the one rating with insufficient testpassers.

Similarly, negative apportionment is used when too many advancements were made. In its simplest form, this can occur when one rating has exceeded its authorized strength (i.e., it has negative advancements required). Assuming that all other ratings meet their advancements required, there will be a surfeit at the all-Navy level equal to the amount by which the one rating has exceeded its authorized strength.

Regardless of whether positive or negative apportionment is being performed, the procedure will gradually change the number of advancements in some (perhaps most) ratings for the paygrade.

Figure 4 is a simplified illustration of negative apportionment. Advancements out and carrydown were not being considered for the end-strength computation (i.e., as if the paygrade shown were E-9). In addition, a three-rating Navy is used for clarity, but the same principles can be extended to include 100 (or more) ratings.

	Rating A	Rating B	Rating C	All Navy
Authorized Strength	125	325	250	700
Net Inventory	100	200	300	600
Advancements Required	25	125	-50	100
Testpassers	75	150	100	325
Pre-apportionment Advancements	25	125	0	150
Pre-apportionment End Strength	125	325	300	750
Pre-apportionment End Strength to Authorized Strength Ratio	100.00	100.00	120.00	107.14
Post-apportionment Advancements	11	89	0	100
Post-apportionment End Strength	111	289	300	700
Post-apportionment End Strength to Authorized Strength Ratio	88.80	88.92	120.00	100.00

Figure 4. Example of negative apportionment at a particular paygrade.

Within each rating, subtraction of net inventories from authorized strengths yields vacancies. However, in this simplified example, this value is also the advancements required. The pre-apportionment advancements represent either the number of test-passers or the advancements required, whichever is less. With pre-apportionment advancements derived, the pre-apportionment end strength and the ratio of end strength to authorized strength can be computed. When summed over the three ratings, the all-Navy end strength (750) exceeds authorized strength (700). The difference is largely attributable to Rating C's overmanning. At this point, a negative apportionment procedure is applied. The ratio of pre-apportionment end strength to authorized strength will be reduced by eliminating some advancements in those ratings that had advancements (A and B). The procedure must reduce total advancements enough (50) so that all-Navy end strength equals authorized strength. Note that this does not necessarily have an equal effect on the reduction of advancements in the ratings. Rating A has lost 56 percent (14, from 25 to 11) of its advancements in the apportionment process, while Rating B has lost only 29 percent (36, from 125 to 89). The result of the apportionment process is that the all-Navy requirements have been met.

Complicating Factors

For clarity, the numerical examples of this report have been simplified. Additional factors make actual advancement planning more difficult. First, not all advancements are planned centrally. Advancement planning is complicated by decentralized, or nonexamined, advancements. The advancement planner has no control over the number, the distribution over time, or the distribution over ratings of these advancements. While these advancements may not necessarily impact advancement planning negatively, they must be considered because they fill (or overfill) vacancies.

The two types of nonexamined advancements are automatic advancements and miscellaneous advancements. Automatic advancements are given to personnel upon the completion of some form of training (usually "A" School). They currently make up approximately 25 percent of the advancements into E-4 and are usually reserved for the highly technical fields. Miscellaneous advancements include meritorious advancements,

Command Authorization Program (CAP) advancements, restorations to grade after demotion, and field advancements. Nonexamined advancements complicate planning because they must be forecast accurately before the number of examined advancements necessary to meet end strengths can be determined.

In addition, the Navy's "token policy" requires that there be some minimal advancement flow in each rate over some period regardless of whether advancements are required. The policy is intended to boost morale by providing at least a small measure of advancement opportunity, even in rates that are chronically overmanned. While the policy may be beneficial to morale, it makes it more difficult for the overmanned rate to come down to its authorized strength.

The Navy's enlisted rating structure further complicates advancement planning. Throughout the discussion of advancement planning, all ratings were assumed to exist independently of one another from paygrades E-4 through E-9, except for purposes of apportionment. This is often not the case. Many ratings belong to groups, called families. Rating families consist of two or more ratings which join together or separate at a paygrade. For example, the Gas Turbine Systems Technician (Electrical) and Gas Turbine Systems Technician (Mechanical) exist independently at paygrades E-4 through E-7 but combine to form Gas Turbine Systems Technician at paygrade E-8 and remain so at E-9.

With the existence of rating families, the straightforward computation of vacancies and advancements required is no longer possible: The assumption that rating advancements into a paygrade equal rating advancements out of the paygrade below no longer holds. Instead, the advancement planner must track the current rating structure and allocate adequate advancements among family members.

THE ADVANCEMENT INTERFACE SYSTEM (ADIN)

The new ADIN system was designed and developed in fiscal year 1983. Since fiscal year 1984, it has been the primary tool used by the Navy's enlisted advancement planner (OP-135C3) to schedule advancements. ADIN is a system of databases, models, user interfaces, and report generators. The system is diagrammed in Figure 5.

ADIN was designed to improve on the old model in the following ways: First, the new ADIN required convenient access to the most up-to-date historical and forecast inventory and personnel flow data. Second, the system needed to incorporate complex carrydown and apportionment calculations. Finally, ADIN needed to be easier to use than the former batch-oriented program.

Major improvements in ADIN start with its databases. The database stores inventory and personnel flow data (attrition, retirements, laterals, demotions, etc.) by paygrade and rating from two primary sources--official transactions data and outputs of personnel projection models. The transactions data include monthly inventory counts from the Enlisted Master Record (EMR), frequency counts of monthly personnel flows, and cyclical data on personnel who have passed examinations. For projected data, ADIN uses forecast values of month-by-month inventories and flows from the Strength Planning Model, SPAN. Operating at the all-Navy level, SPAN provides monthly ceilings on total advancements to each paygrade. To account for rating-specific behavior, ADIN gets annual projections from the FAST Model. Finally, the AUTOA Model supplies ADIN with monthly projections of automatic advancements for each rating.

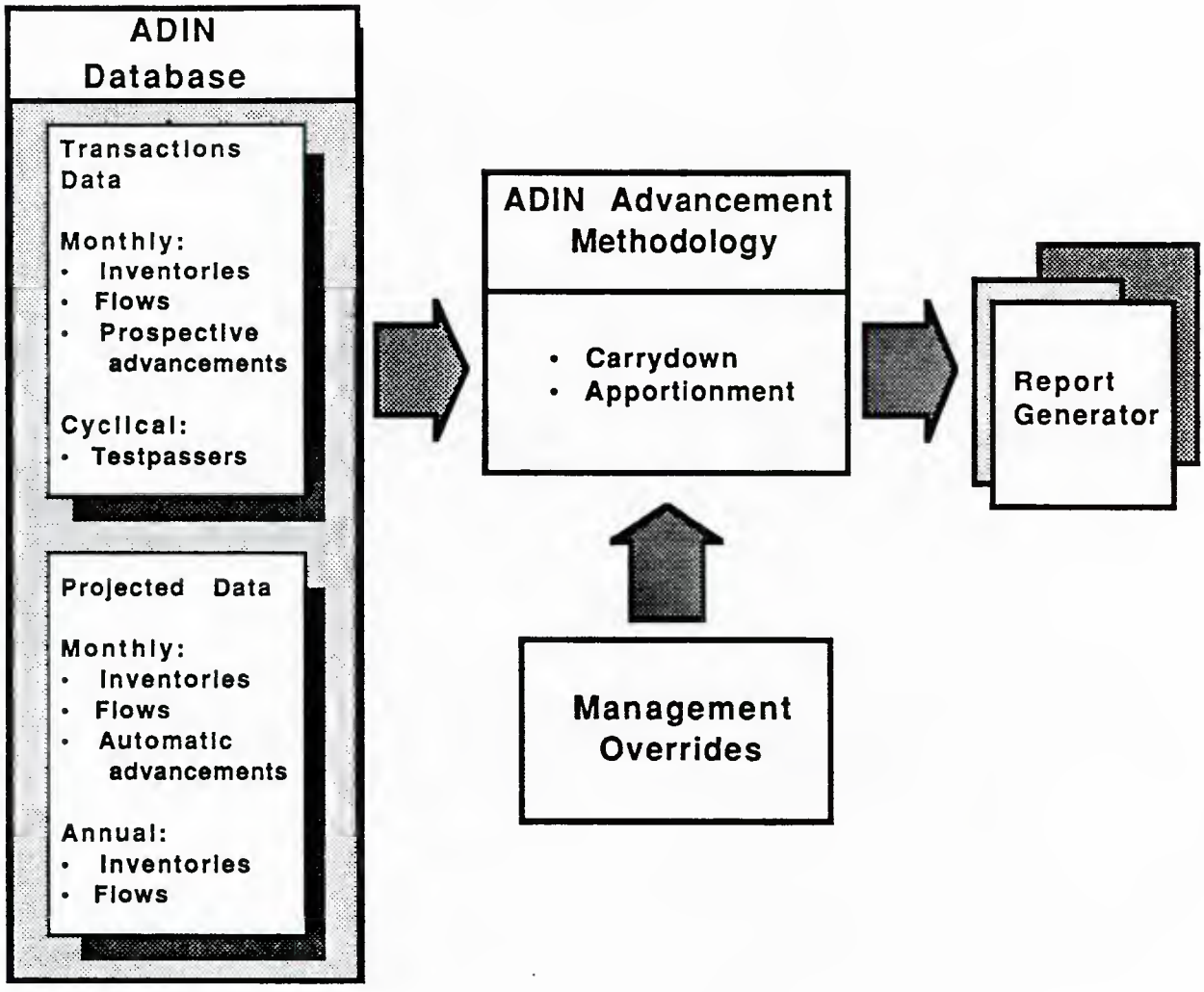

Figure 5. The Advancement Interface System (ADIN).

As a first step in developing an advancement plan, ADIN reconciles discrepancies between this mixture of actual and forecasted data. During the reconciliation, the advancement planner may select which of the projection model results should be used to resolve differences. Then, combining the results, ADIN makes its own forecasts of losses, gains, and nonexamined advancements.

Occasionally, the advancement planner has more current information than is available in the ADIN database or wants to conduct "what if" exercises. ADIN accommodates this requirement by permitting overrides to any of the values in the database. These "management overrides" do not permanently change any of the database entries. Instead, they are used only when specifically requested by the user.

The heart of the system is a series of programs that manipulate actual and projected data as well as the managerial overrides by using the carrydown and apportionment procedures. The result is a schedule of monthly advancements by rate over a cycle.

The primary output of an ADIN "run" is a machine-readable magnetic tape file. From this file, the user can elect to produce a variety of reports. For example, the user can examine a summary report before requesting more detailed reports. The tape output can be saved so additional reports can be produced later.

Typically, advancement planners are midgrade officers with little or no computer experience. With the old planning model, they struggled with a poorly documented, batch program. Despite their lack of experience, they were forced to spend considerable time processing data and manipulating programs and data sets just to create a plan. This effort came at the expense of analyzing data and developing and evaluating alternative plans. Frequently, planners required external assistance to run the model. ADIN, through its interactive "front-end," significantly reduces the computational burden on planners. A series of menus now offers choices that identify the part of the system to be exercised (e.g., database update, database query, reports), specify the overrides to be applied, or control aspects of the advancement procedures to be used.

CONCLUSION

While the ADIN system is serving as the key tool of the enlisted advancement planner, work to improve the system continues. Recent developments include improvements in the user interface, the addition of reports for users other than the advancement planner, and an audit trail that recaptures and displays user inputs on the reports.

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